Harvest Weed Seed Control Factsheet Series
HWSC Overview

While harvest weed seed control can be accomplished by a variety of methods, seed impact mills and chaff lining (shown above) are the most common types in use today. (Photo credit: Claudio Rubione, GROW)

What is Harvest Weed Seed Control?

Harvest Weed Seed Control (HWSC) is the practice of capturing and managing weed seeds with harvest operations. At harvest time, combines can unintentionally turn into weed seed spreaders, due to weed escapes in the field that have produced seeds. If these weeds stand above the cutter bar, they can enter the combine during harvest. Most weed seeds exit the combine via chaff material. The combine then spreads these seeds behind it in the field in the chaff residues, creating a wider distribution of weeds for subsequent seasons.

Harvest weed seed control tactics disrupt this weed seed dispersion by either destroying, confining, or removing weed seeds that enter the combine during harvest, impacting all seeds, herbicide-resistant weeds and non-resistant weeds alike. Harvest weed seed control can greatly reduce the number of weed seeds, as well as volunteer crop seed, entering a field's seedbank at the end of the growing season, which reduces weed pressure in subsequent seasons. Ultimately, these kinds of management practices act as a backstop for weed control, giving farmers the final say for the season and a jump on next seasons' weed control.

While harvest weed seed control can be accomplished by a variety of methods, **seed impact mills and chaff lining are the most common types in use today.**

What are the Primary Systems of HWSC?

Chaff Lining

Chaff lining funnels the chaff portion (including weed seeds) into a narrow line behind the combine during harvest and left in place. Straw is still spread out as normal. This practice concentrates weed seeds into the chaff line, (typically 12 to 18 inches wide). In those narrow bands across the field, weed seeds are less competitive than weed seeds spread across an entire field. Weed seed emergence is also often reduced in the chaff line. Chaff lining is a good entry-level harvest weed seed control option due to low upfront costs, the ability to work with any type of combine, and DIY-friendly construction requirements (https://growiwm.org/try-chaff-lining-an-diy-friendly-form-of-weed-control/).

For an in-depth review of chaff lining, see the GROW webpage devoted to it here: https://growiwm.org/chaff-lining/

Seed Impact Mills

In this method, mills are attached to the back of the combine to crush and process the chaff residue, injuring or destroying any weed seeds within the chaff, before spreading it back across the field. This system returns all residue to the field evenly in a single pass. This technology is usually considered the ultimate form of harvest weed seed control, but it comes with significant upfront costs and requires a Class 8 or larger combine: https://growiwm.org/tag/seed-impact-mill/.

For an in-depth review of seed impact mills, see the GROW webpage devoted to it here: https://growiwm.org/seed-impact-mills/

1. Are there other systems for HWSC?

There are four other methods of harvest weed seed control in use today, though less common than seed impact mills and chaff lining.

Four of the six HWSC systems—chaff lining, seed impact mills, chaff tramlining, and chaff carts—target only the chaff, whereas bale direct and narrow windrow burning target both the chaff and the straw residues leaving the combine. Many combines require the installation of a baffle to keep the chaff and straw separate. For a quick overview of the pros and cons of each method, see Figure 1 on page 4.

Chaff Tramlining

Here, chaff is funneled into narrow rows that align with the two wheel tracks of a farmer's equipment. In a "controlled traffic farming system," a grower uses only these dedicated wheel tracks—or tramlines—as they move equipment through the field. This reduces overall soil compaction and produces an unfavorable environment for weed seeds within the tramlines, due to factors such as soil compaction and plant injury from equipment.

Chaff Carts

Imported from Canada, chaff carts (sometimes called "chaff wagons") follow behind a combine and collect chaff harvest materials, where most weed seeds end up. Chaff can be dumped in the field for subsequent management or removed from the field. Chaff can be a valuable feedstuff for livestock.

Chaff cart. (Photo credit: Michael Flessner, Virginia Tech)

Bale Direct

A baler is attached directly to the combine, which bales chaff and straw residues as well as weed seeds in the harvest residues. If a market exists for them, the bales can be sold for bedding or livestock feed.

Narrow Windrow Burning

In this method, all harvest residues—including chaff, straw, and weed seeds contained within them—are funneled into a narrow row, where weed seeds can be destroyed by burning. This method has proven effective at destroying weed seeds, but comes with significant fire risks and other trade-offs to soil health: https://growiwm.org/narrow-windrow-burning-for-weed-seed-control-is-risky-business/. Local burning regulations may also exist.

HWSC System	+	−
Seed Impact Mills	• Complete and even distribution of crop residues • One-pass system • Kills weed seeds	• High up-front costs • Increased fuel use • Potential for slower harvests • Difficult to estimate harvest losses
Chaff Lining	• Very low up-front costs • One-pass system • Ease of adoption	• Weed seeds not killed and remain in field • Potential for residue build-up • Planting into chaff lines potentially problematic
Chaff Tram-lining	• Uses less horsepower than a seed impact mill • Low up-front costs • One-pass system • Ease of adoption	• Requires controlled traffic farming system for best results • Weed seeds not killed and remain in field • Potential for residue build-up • Planting into tramlines potentially problematic
Chaff Carts	• Concentrates/removes weed seeds • Can be valuable feed for livestock	• Requires towing with a combine • Must deal with chaff dumps after harvest • Nutrient and crop residue removal
Bale Direct	• Removes weed seeds • Can be valuable feed for livestock • Potential revenue from bales	• Requires towing with a combine • Combines two complicated pieces of machinery • Requires a market for bales • Extra activity after harvest • Nutrient and crop residue removal
Narrow Windrow Burning	• Very low up-front costs • All weed seeds entering the combine end up in the windrow • Kills weed seeds • Ease of adoption	• Risk of fire escaping windrows • Burning generates smoke • Nutrient and crop residue removal • Requires good, even burn across all windrows • Extra activity after harvest

Figure 1. Pros and cons of each harvest weed seed control method. Chart credit: Michael Flessner, Virginia Tech, and Emily Unglesbee, GROW

2. Which weeds are best controlled by HWSC?

For harvest weed seed control to be effective, **seeds must be retained on the weed plant at harvest.** Seeds on the ground or lower than the cutter bar cannot be controlled with these methods. The timing of weeds' seed drop can vary by species, region, and even season to season. But in general, upright annual broadleaf weeds are the best targets, followed by annual grasses. While harvest weed seed control methods do not control perennial structures such as tubers and rhizomes, they can help reduce the spread of perennial weeds by their seed. Lastly, we don't know how well wind-dispersed seeds, such as horseweed, are captured by the combine. See the following table for a breakdown of soybean and wheat weeds by their seed retention at harvest, how long their seeds remain viable in the seedbank, and their overall harvest weed seed control potential (Figure 2).

Harvest Weed Seed Control Potential

SOYBEAN WEEDS			
Species	Seed Retention	Seed Survival*	HWSC Potential**
BROADLEAVES	**%**	**years**	
Common cocklebur	94	< 5	GOOD
Common lambsquarters	60	>10	POOR
Common ragweed	66	< 5	FAIR
Giant ragweed	58 to 80	< 5	GOOD
Hemp sesbania	100	5 to 10	EXCELLENT
Jimsonweed	98	>10	FAIR
Kochia	100	< 3	EXCELLENT
Palmer amaranth	99	< 5	EXCELLENT
Prickly sida	60 to 90	< 5	GOOD
Redroot pigweed	85	< 5	EXCELLENT
Sicklepod	83	< 5	GOOD
Smooth pigweed	98	< 5	EXCELLENT
Velvetleaf	50 to 88	>10	POOR
Waterhemp	>93	< 5	EXCELLENT

Figure 2: Weed species ranked by their harvest weed seed control (HWSC) potential, based on their seed retention rates at harvest time and how long their seeds remain viable in the seedbank. Figure continues on next page. (Chart credit: Eli Russell, Virginia Tech; Michael Flessner, Virginia Tech; and Emily Unglesbee, GROW)

2. Which weeds are best controlled by HWSC? (cont.)

GRASSES			
Barnyardgrass	90	< 5	GOOD
Broadleaf signalgrass	50	5 to 10	POOR
Giant foxtail	55	< 3	FAIR
Goosegrass	92	< 5	EXCELLENT
Johnsongrass***	98	5 to 10	GOOD
Junglerice	91	< 5	EXCELLENT
Large crabgrass	54	< 3	FAIR
Texas panicum	68	>10	POOR

WHEAT WEEDS			
Species	Seed Retention	Seed Survival*	HWSC Potential**
BROADLEAVES	**%**	**years**	
False cleavers	>55	< 5	FAIR
Canola	95	< 5	EXCELLENT
GRASSES			
Cheatgrass / Downy brome	< 50 to 75	< 5	FAIR
Feral rye	50 to 90	< 5	GOOD
Italian ryegrass	< 50 to 58	< 3	FAIR
Perennial ryegrass***	58	< 5	FAIR
Rat-tail fescue	< 50	< 5	FAIR
Joated goatgrass	76	< 5	GOOD
Wild oat	40 to 55	>10	POOR

*Years for approximately 90% seed death

**Rating scale ranges from poor to fair, good and excellent HWSC potential. Ratings assume a timely harvest and optimum combine/harvester set-up.

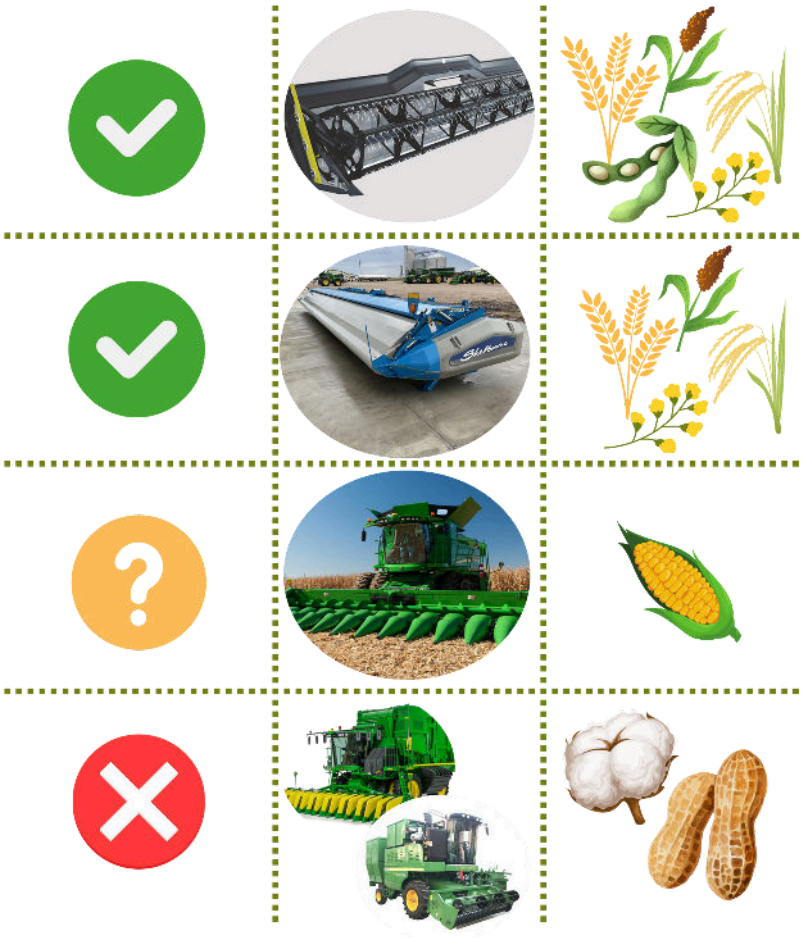
***HWSC will reduce seed spread of perennial species, but will not control vegetative portions of the plant like rhizomes or tubers.

Figure 2 continued: Weed species ranked by their harvest weed seed control (HWSC) potential, based on their seed retention rates at harvest time and how long their seeds remain viable in the seedbank. (Chart credit: Eli Russell, Virginia Tech; Michael Flessner, Virginia Tech; and Emily Unglesbee, GROW)

3. What crops are best suited for HWSC?

In general, **harvest weed seed control technology relies on the likelihood of weed seeds making it into and through a combine during harvest.** As a result, crops where HWSC methods work best tend to be grain crops harvested by combine headers that maximize the capture of weed seeds (see Figure 3).

Small grains such as wheat, soybeans, canola, rice, sorghum, and dry beans—typically harvested with platform headers (also called draper or grain headers)—have proven to be good candidates for harvest weed seed control. Likewise, stripper headers have proven adept at capturing weed seeds. Although less research exists on corn harvest weed seed capture, recent findings led by the University of Missouri and Virginia Tech suggest that weed seed capture with corn headers is variable and significantly lower than with platform or stripper headers, though it can be improved with certain header modifications (https://growiwm.org/can-a-corn-header-capture-weed-seeds/). Preliminary findings show that 20% to 80% of weed seeds escape at the corn header and thus are not subjected to HWSC: https://growiwm.org/this-harvest-device-catches-corn-kernels-and-weed-seeds/.



Finally, crops harvested with entirely unique harvest equipment—such as cotton and peanuts—are not good candidates for harvest weed seed control methods, due to a lack of compatibility with commercially available HWSC equipment options today.

However, researchers from Texas A&M University are analyzing the ability of cotton pickers and strippers to capture weed seeds to aid future exploration of the use of seed impact mills in cotton: https://growiwm.org/can-seed-impact-mills-kill-weed-seeds-in-cotton/.

Canadian researchers are also evaluating HWSC in potato production: https://doi.org/10.1139/cjps-2023-0114.

Figure 3: A chart showing the suitability of certain harvest equipment and cropping systems to harvest weed seed control, based on technology available at this time. Crops harvested with a grain or platform header—such as small grains, soybean, rice, canola, and sorghum—are good fits for HWSC. (Chart credit: Michael Flessner, Virginia Tech, and Emily Unglesbee, GROW)

4. How do you set up a combine for maximum weed seed capture?

Harvest promptly. Weed seeds need to be retained on their plant at harvest (see Section 2), for harvest weed seed control methods to be effective. The longer harvest is delayed, the more seeds will fall and escape the combine.

Harvest low. Seeds can be knocked off the plant by the action of the cutter bar and reel. Research from the University of Missouri has shown waterhemp has 22-40% seed loss at the header. Having properly adjusted reel speed, height, position, and angle is important to maximize weed seed capture. Weed seeds below the cutter bar will not enter the header. While harvesting lower means processing more material, it can increase weed seed capture.

Get clean grain into the grain tank. Weed seeds need to exit the combine in the chaff stream, not through the straw spreader. In general, when combine settings achieve clean grain entering the grain tank with minimal sieve loss, weed seeds exiting in the chaff is maximized.

Check out these resources to set up your combine. Adjusting your combine for maximum weed seed capture can actually reduce fuel use and reduce grain losses, too.

- **Farmer Forum Recap: How to Set Up Combine Headers for Weed Seed Capture: https://www.youtube.com/watch?v=5nXsraYfCmc&t=234s**
- **Farmer Forum Recap: How to Optimize Threshing and Separating for Harvest Weed Seed Control: https://www.youtube.com/watch?v=0XFXD3dDqmU&t=1s**

5. How long does it take for HWSC to have an effect?

This question is currently the focus of ongoing research in the U.S. So far, researchers have found that waterhemp in the seed bank has been reduced by 96% to 98% in just two years with seed impact mill use in Missouri (https://doi.org/10.1017/wet.2023.20). However, while rigid ryegrass density declined every year in Australia (https://doi.org/10.1614/WT-D-12-00181.1), it took five to eight years before fully realizing the potential of HWSC. Other research has seen about a 30% reduction in weed density after one harvest with simulated seed impact mills (https://doi.org/10.1017/wet.2019.46).

6. How much does HWSC cost?

The cost of harvest weed seed control varies widely by method used.
The chart below (Figure 4) provides a general comparison of the cost per acre between the different methods in use today, in U.S. dollars.

Up-front costs can vary substantially—from less than $1,000 for do-it-yourself chaff lining to around $70,000 for a seed impact mill.

You can use this digital calculator, adapted from **WeedSmart,** to customize the cost of HWSC for your farm: https://growiwm.org/wp-content/uploads/2025/10/GROW-Cost-of-HWSC-Calculator-2025-1.xlsx

Harvest Weed Seed Control Method	Total Cost Per Acre
Chaff Lining	$4.97
iHSD	$11.21
Redekop SCU	$12.24
Seed Terminator	$12.86
Narrow Windrow Burning	$20.96

Figure 4. The average estimated cost per acre of individual harvest weed seed control methods. Total costs include the purchase price, maintenance, amortization, depreciation, and replacement costs for nutrients where applicable. (Chart credit: GROW & Michael Flessner, Virginia Tech)

Authors, Resources and Citations

Authors
Eli Russell, Virginia Tech
Emily Unglesbee, GROW
Michael Flessner, Virginia Tech

Editors
Claudio Rubione, GROW
Mark VanGessel, University of Delaware

Reviewers
Breanne Tidemann, Agriculture & Agri-Food Canada
Lovreet Shergill, Colorado State University

CITE AS: Flessner, M., Russell, E., Unglesbee, E. (2025). Harvest Weed Seed Control. Getting Rid of Weeds (GROW) Through Integrated Weed Management. https://growiwm.org/how-harvest-weed-seed-control/

Beam SC, Mirsky S, Cahoon C, Haak D, Flessner M. Harvest weed seed control of Italian ryegrass [Lolium perenne L. ssp. multiflorum (Lam.) Husnot], common ragweed (Ambrosia artemisiifolia L.), and Palmer amaranth (Amaranthus palmeri S. Watson). Weed Technology. 2019;33(4):627-632. https://doi.org/10.1017/wet.2019.46

Davis AS. Weed Seed Pools Concurrent with Corn and Soybean Harvest in Illinois. Weed Science. 2008;56(4):503-508. doi:10.1614/WS-07-195.1

Goplen JJ, Sheaffer CC, Becker RL, et al. Giant Ragweed (Ambrosia trifida) Seed Production and Retention in Soybean and Field Margins. Weed Technology. 2016;30(1):246-253. https://doi.org/10.1614/WT-D-15-00116.1

San Martín C, Thorne ME, Gourlie JA, Lyon DJ, Barroso J. Seed retention of grass weeds at wheat harvest in the Pacific Northwest. Weed Science. 2021;69(2):238-246. https://doi.org/10.1017/wsc.2020.91

Schwartz-Lazaro LM, Green JK, Norsworthy JK. Seed Retention of Palmer amaranth (Amaranthus palmeri) and Barnyardgrass (Echinochloa crus-galli) in Soybean. Weed Technology. 2017;31(4):617-622. https://doi.org/10.1017/wet.2017.25

Schwartz-Lazaro LM, Shergill LS, Evans JA, et al. Seed-shattering phenology at soybean harvest of economically important weeds in multiple regions of the United States. Part 1: Broadleaf species. Weed Science. 2021;69(1):95-103. https://doi.org/10.1017/wsc.2020.80

Schwartz-Lazaro LM, Shergill LS, Evans JA, et al. Seed-shattering phenology at soybean harvest of economically important weeds in multiple regions of the United States. Part 2: Grass species. Weed Science. 2021;69(1):104-110. https://doi.org/10.1017/wsc.2020.79.

Authors, Resources and Citations

Soni N, Nissen SJ, Westra P, Norsworthy JK, Walsh MJ, Gaines TA. Seed retention of winter annual grass weeds at winter wheat harvest maturity shows potential for harvest weed seed control. Weed Technology. 2020;34(2):266-271. https://doi.org/10.1017/wet.2019.108

Tidemann BD, Hall LM, Harker KN, Beckie HJ, Johnson EN, Stevenson FC. Suitability of Wild Oat (Avena fatua), False Cleavers (Galium spurium), and Volunteer Canola (Brassica napus) for Harvest Weed Seed Control in Western Canada. Weed Science. 2017;65(6):769-777. https://doi.org/10.1017/wsc.2020.79

Winans T, Massey R, Schreier H, Bish M, Bradley KW. Harvest weed seed control in soybean with an impact mill. Weed Technology. 2023;37(2):113-122. https://doi.org/10.1017/wet.2023.20

Walsh, M.J., Broster, J.C., Schwartz-Lazaro, L.M., Norsworthy, J.K., Davis, A.S., Tidemann, B.D., Beckie, H.J., Lyon, D.J., Soni, N., Neve, P. and Bagavathiannan, M.V., 2018. Opportunities and challenges for harvest weed seed control in global cropping systems. Pest Management Science, 74(10), pp.2235-2245. https://doi.org/10.1002/ps.4802

Walsh M, Newman P, Powles S. Targeting Weed Seeds In-Crop: A New Weed Control Paradigm for Global Agriculture. Weed Technology. 2013;27(3):431-436. https://doi.org/10.1614/WT-D-12-00181.1